of modern climatologists. A uniform standard of time is used, namely, that of eight hours east of Greenwich, which is, we believe, also the time shown by the time ball at the observatory for the use of the shipping. 8 a. m. at Washington is simultaneous with 9 p. m. of the same date at Manila. The record for a single month, at all 44 stations, occupies about 93 or 94 pages, and the twelve months, without an annual summary, make up an imposing volume of 1128 pages, from which one may see that the pages are not crowded with figures. This suggests the remark that considerable extravagance with regard to space and pages is shown in nearly all tabular matter that has hitherto been published under American auspices. We notice that in corresponding publications by European nations twice as much material is crowded into a single quarto page without destroying, but in fact increasing, the convenience with which one uses the data. Still it must be confest that very few nations have made their original daily records so accessible to climatologists as these of the Philippines, and we believe the result will be greatly to the advantage of these islands, since the superior attractiveness of their climates can now be more fully appreciated.

With this volume we receive also a copy of the Far Eastern Review, Vol. II, No. 13, for May, 1906, which is especially devoted to the Moro Province and the island of Mindanao. We owe this to the kindness of our former colleague, now Capt. John P. Finley, U. S. A., Governor of the District of Zamboanga and founder of the Moro Exchange at that place. As many of our readers are teachers of geography and climatology and will wish to do justice to these distant American possessions, we must refer them to this Far Eastern Review for details as to the climate and country. Brentano's (incorp.) is the American agency.

LUNAR RAINBOW AT TAMPA, FLA.

By J. S. HAZEN, Local Forecaster. Dated October 30, 1906.

A peculiar and interesting meteorological condition prevailed over this vicinity during the passage of a West Indian storm over the Gulf on October 1, 2, and 3. On October 1, from 8:30 to 10:30 p. m., fully eight-tenths of the sky was covered by a striated form of cirro-cumulus clouds, making a uniform banded appearance which was very striking. The appearance was much like the segments of a gigantic orange over portions of the sky. The bands were apparently about 10° in width at the zenith, decreasing somewhat toward the horizon, and were well defined and distinct from the intermediate spaces, which were apparently clear of clouds and of about the same width.

About 9 p. m. a brilliant and perfect lunar corona was observed, the prismatic colors being especially well defined, and running from purple to pale lavender. There was also a double row of concentric rings showing prismatic colors, outside the first corona. On the 2d and 3d of October lunar rainbows were observed, that on the 2d being especially brilliant and an object of much interest to many people in Tampa who saw it. A slight thunderstorm past west of the station early in the evening, and rapidly moving, massive cumulus clouds were drifting across the sky near the western horizon during the time the bow was noted.

The bow was a perfect arch, and showed all prismatic colors with remarkable distinctness. It reached at one time high above a large mass of cumulus clouds, showing with equal distinctness against the back ground of dark cumulus clouds and the apparently clear sky above the cloud. Stars could be seen thru the bow with brilliancy very little diminished, if any. Both phenomena were observed by many in this city. It is understood that a lunar rainbow was observed in Pensacola also about this time.

The lunar rainbow is such an unusual occurrence that the writer would be pleased to have editorial comment pertaining to meteorological conditions necessary for the display of such phenomena, and whether or not the passage of a West Indian storm would bring about meteorological conditions likely to result in such phenomena.

It occurs to the writer that certain extensive movements of the upper air must be necessary to result in such a condition as was observed here on the dates mentioned.

EDITORIAL.—On the evening of October 1 the above-mentioned storm center was two or three hundred miles northwest of Tampa, and whatever the local winds may have been at that place the general drift of the atmosphere above it seems to have been from the south and east. This upper current was not necessarily at any great elevation, and below it was the usual layer, a few thousand feet in thickness, of relatively quiet air. Under these conditions a series of atmospheric waves, each of them many miles in length and possibly a mile or two in breadth, is usually formed.[1] The upper portion, or crest, of each billow becomes visible by a little cloudy condensation, while the lower portion is formed of relatively clear air. These crests and troughs must have extended eastward and westward in this case, or perhaps northeastward and southwestward, over Tampa, in parallel lines toward the distant horizon, and the observer, looking upward, should have seen them by perspective tapering toward the two opposite vanishing points, and covering the sky with markings analogous to the gores of a gigantic balloon. The width of each gore, or band, is stated by Mr. Hazen to have been about ten degrees at the zenith, and if the clouds were five or six thousand feet above him, this would correspond to about one thousand feet in linear distance.[2] If we knew the exact height and width of the billows, we could compute approximately the velocity of the wind at that elevation.

A corona, or glory, is formed by light shining thru a layer of small particles, such as dust, or fog, or crystals (spiculæ) of ice. If the observer had given the diameters of some of the rings of color composing the corona, something could have been inferred about the size and shape of these particles; but the fact that he does not mention the size, nor state whether the purple rings were inside or outside of the lavender rings makes it difficult to decide whether we have to do with a corona or a halo.

On the 2d and 3d of October lunar rainbows were observed. These require the presence of drops of water of appreciable size, and are not especially rare, but it is interesting to notice that they occurred apparently long after the passage of a slight thunderstorm on the 2d, and again quite independently of any rain on the 3d. The drops needed to form the lunar rainbows must, therefore, have been thinly scattered thru the clear air and may have evaporated in falling to the ground.

The passage of a West Indian hurricane is believed not to be necessary as preliminary to the appearance of such rainbows and coronas, and we hope that several of the observers in Florida will give us statistical studies of the relations between storms and halos, coronas and rainbows, based upon the records of their respective stations.—*C. A.*

THE ORIGIN OF OUR COLD WAVES.

It has for a long time been desirable to obtain observations and daily maps that would throw light upon the rival hypotheses as to the origin and nature, or the mechanics, of the areas of high pressure and cold, dry air that descend from the northwest, north, and sometimes the northeast upon the United States.

According to one, these are due to upper westerly winds blowing over the Rocky Mountains toward areas of low pressure. The air becomes clear and dry as it descends the eastern

[1] See Helmholtz on "Atmospheric Motions," translated in "Mechanics of the Earth's Atmosphere."

[2] One degree is 1/57.3 part of the radius.

slope, and cools by radiation faster than it warms up by compression and insolation.

According to another, these are horizontal protrusions southward from the great areas of cold air lying close to the ground in Arctic America. It is supposed that only a very thin lower layer is drawn southward by the development of areas of low pressure in Tropical America, the Gulf States, and the West Indies.

According to a third theory, there is a cold upper anti-trade flowing from equatorial regions to the Arctic on a gradient so gentle that its clear air cools to the lowest temperatures—so low that, when it finally descends in latitudes 50° to 70°, its warming by compression does not raise its temperature above the —50° or —30° that is observed in our severest cold waves.

It may well be that all three of these views must be combined together in order to explain the actual processes of nature. Doubtless we shall need to obtain more data from the upper air by means of kites and balloons, but meanwhile Prof. R. F. Stupart has directed attention toward the possibility of compiling daily weather maps extending northward beyond the Arctic Circle as being the first requisite to the successful study of the question, and we print as Charts IX–XIV of this REVIEW a series of his maps for January 13–18, 1904, as illustrating what is now possible in this line of work. There is no doubt but that steady progress will be made in filling up the blank spaces over the great frozen region of North America, and that eventually the charts will abundantly represent the conditions at the lower level of the atmosphere. But the data for upper levels will, we fear, still be rather scanty, so that for these we shall necessarily rely upon deduction rather than observation.

Even now, however, we already perceive many analogies between these North American maps and those of Europe and Asia, so that these combined with similar ocean maps represent one simple mechanical circulation. We must learn to study the whole Northern Hemisphere, or the whole globe, on a globular surface instead of on the plane surfaces that are offered by our various misleading styles of cartographic projection.—*C. A.*

METEOROLOGY IN AUSTRIA.

The Imperial Centralanstalt for Meteorology and Geodynamics published its first annual volume, or Jahrbuch, for the year 1855, and a new series began with 1863. Many of these volumes contain not merely elaborate climatological data, but additional material, sometimes published as an Anhang, or Appendix, and we make the following notes on the appendix to the volume for 1904, which was received during August, 1906.

MEAN ATMOSPHERIC PRESSURE.

The distribution of atmospheric pressure over central and southern Europe was the subject of an important memoir by Hann, published in 1887, in Volume II of Penck's Geographical Memoirs. Therein Hann mentions the difficulty of finding the stations at which the more important series of observations have been made, owing in part to frequent changes. In order to obviate this trouble Margules recommends that from time to time, if possible yearly, or at least every five years, the recent observations should be combined with the older series, thus maintaining a continual revision of the annual and monthly averages. He has, therefore, compiled the records that have accumulated since the close of Hann's work, viz, for nineteen years, 1886–1904, inclusive. In order that all may be reduced to an absolute standard of pressure he states that we must first have a station whose barometer has not changed during the whole interval, and in order to assure ourselves of this the barometers used at the central station must be compared annually with an absolutely correct barometer; but this, he says, has never been done in Austria, and we believe we may add that it has not been done elsewhere. There are in fact, so far as we know, but three institutions in the world, viz, the Central Physical Observatory at St. Petersburg, the International Bureau of Weights and Measures, at Sévres, near Paris, and the Bureau of Standards or Reichsanstalt, at Charlottenberg, near Berlin, that possess true normal barometers, so constructed that every imaginable source of error can be investigated. The barometric work done by meteorological offices thruout the world has not yet attained to a precision comparable with that attained in their own thermometric observations. Even the most accurate physicists investigating the properties of gases seem to be liable to assume the accuracy of their barometric work, while pushing the thermometric measurements to the highest refinements. The mercurial barometers used by meteorologists need careful calibration and frequent comparisons in order to enable us to detect the changes going on in their instrumental corrections.

Margules finds himself forced to assume that during these nineteen years the barometer of the Centralanstalt has remained correct and unchanged to within one-tenth of a millimeter. His first step is then to compare the annual mean pressures as observed at Vienna with the means observed at other stations near by at nearly the same level, and more especially those stations whose differences from Vienna have changed but little during the whole period. For instance, the station at Judenburg shows a departure from Vienna of —0.70 millimeters during the first seven years, —0.79 in the next five years, and —0.78 during the third lustrum. The greatest departure in the annual means was —0.95 and the least —0.63. As there was no system in these variations this is called a constant series. The distance between the two stations is 165 kilometers, and the annual means are reduced to the same elevation, 200 meters above the sea level, before comparison. On the other hand an equally important station, Kremsmuenster, at a distance of 160 kilometers, showed the following differences for the successive lustra, namely, 16.38, 16.22, 16.08 millimeters, which looks as tho there had been a steady change in one or the other barometer. Similar systematic changes are found in other cases. These differences are partly explained as dependent upon the distances between the stations, and their directions from one another, in connection with an occasional abnormal distribution of pressure. Such abnormal deviations may have continued, in one case, for three consecutive years, when large barometric depressions lay for a long time to the south of Vienna. Margules concludes that these remarks will interest only the officials of the various meteorological institutions.

The annual volumes contain too many figures, and it is impossible to properly check the computations. Therefore if anyone wishes to use these published figures he must spend much labor in selecting what is best and most appropriate from this excess of material. If this preliminary checking is to be done systematically in the central offices it would result in diminishing the quantity of printed material. He thinks that atmospheric pressure has no direct climatological interest and might properly be published to a very limited degree only. For those purposes to which monthly means of pressure do apply it would suffice to have one station in the low lands, or one high and one low station in the mountain regions, for every circle of one hundred kilometers radius. This is very nearly the same as one barometric station to a circle whose radius is one degree of a great circle, or to every four square degrees, or about two hundred for the area covered by the United States. As there are some problems in the mechanics of the atmosphere that are peculiar to the orography of the North American Continent, we think that for the present at least, until these are solved, it is fortunate that the United States is in a position to publish monthly and annual means reduced to a uniform standard for all of its 175 baro-